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Dynamic Relaxation of Tree Networks in an Electromechanical System

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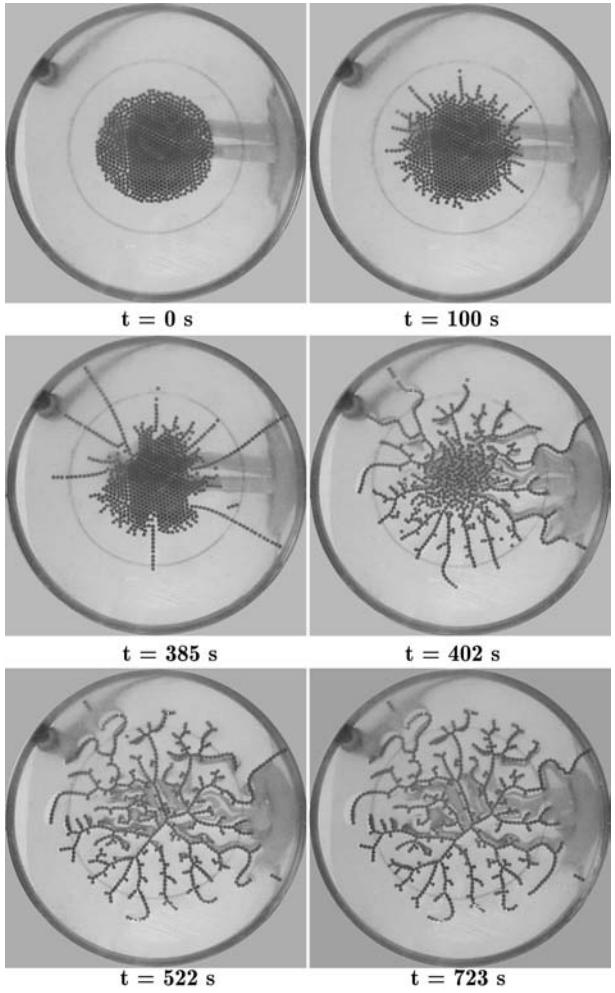
Research

Understanding the dynamic processes that form fractals and fractal-like trees remains a key open problem in physical phenomena as diverse as dielectric breakdown, viscous fingering, fracturing, river formation and in biological phenomena like branching in plants, fungi, and blood vessels. There are two major difficulties posed by studying the dynamics of fractals by experiment: 1) time scales are either too fast (as in dielectric breakdown) or too slow (as in river formation) and 2) control of experimental parameters are often out of the researchers' hands.

We study the relaxation of macroscopic conducting particles under the influence of an electric field. By placing the particles in a viscous dielectric medium, the mechanical relaxation time scales become much slower than the electrical relaxation time scales. This experiment resolves the two major issues involved in studying dynamic fractal formation.



Relaxation sequence starting from a compact initial condition: Before time t =400s, the unconnected particles form chains that compete to reach the grounded electrode. After t =400s, one of the chains meets ground and all other chains quit reaching. The network proceeds to form from the single connected chain.